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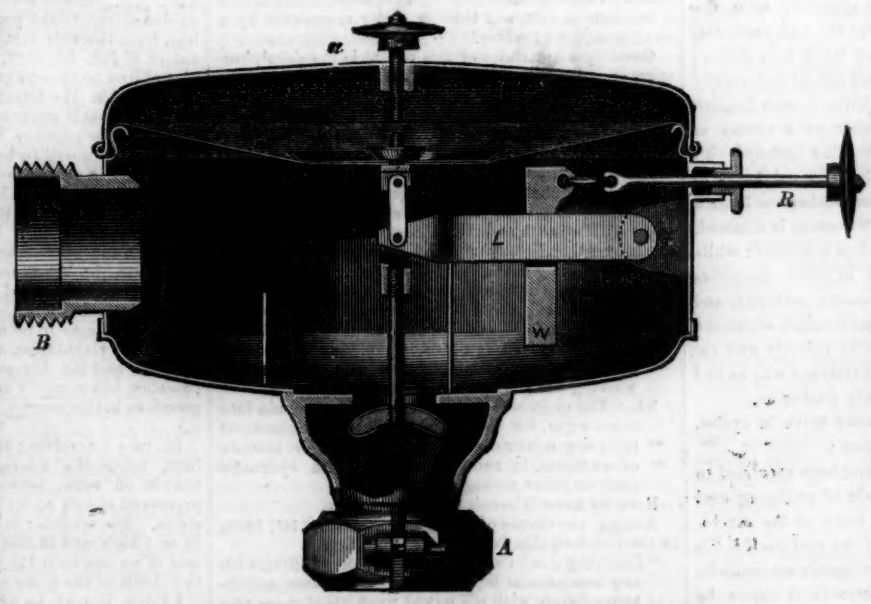
Improved Gas-Pressure Regulator.

It is safe to say, that were a good gas regulator in universal use, it would save the consumers of gas in the United States millions of dollars per annum, while the light would be much more steady and satisfactory. Individual consumers can, by its use, generally average a lessening of their gas bills from 15 to 40 per cent. Hence the importance of maintaining a steady pressure during the combustion of gas, can hardly be over estimated. Upon the proper adjustment of the degree of pressure depends, in a great measure, the economy with which a given amount of gas is consumed; and upon the perfection of the regulating apparatus depends the constancy with which the adjustment can be maintained. When gas issues from the burner under undue pressure it mixes, to a considerable extent, with the atmosphere, before it is burned; and when combustion takes place under such circumstances, the amount of light produced is materially lessened. Moreover, the flame becomes flickering and unsteady; an injurious effect is thereby produced upon the eyes, and although the actual amount of light produced might remain undiminished, the result, for all practical purposes, would be lessened. The only way to secure true economy in the use of gas is to use moderately large burners; to so regulate the pressure that the burner will give the greatest amount of light, and then to maintain it steadily at that point. The first two of these conditions are readily attained, and the device which we are now about to describe affords peculiar facilities for maintaining the third.



IMPROVED GAS PRESSURE REGULATOR.

Pressure regulators of various kinds have long been in use, and some of these are exceedingly perfect and also ingenious. That which is chiefly required for practical purposes, however, is one that will operate well, be easily adjusted, and cost but a moderate sum, and these features are, we think, found to a very large extent in the Pressure Regulator of Mr. Eugene Beggs, of which the accompanying cut is a section, some of the parts being shown in elevation. It is modeled somewhat after the old diaphragm regulators, with this important improvement; that it is easily adjusted by simply drawing out or pushing in a projecting rod. The means by which this adjustment is effected are as follows: The regulator being attached to the meter by the connection at *A*, and the service pipe to the outlet pipe *B*, the pressure of the gas will act on the diaphragm *D*, so as to raise the valve *V*, and diminish the opening through which the gas passes into the regulator, and it is obvious that no matter what may be the pressure of the gas in the meter, the pressure in the regulator will remain constant at a point which will be governed by the extent of surface of the diaphragm as related to the weight of itself and its connections. Whenever any deviation from this pressure occurs, the diaphragm will be raised or lowered to a corresponding extent, the valve will enlarge or diminish the opening through which the gas passes, and the pressure in the regulator will be brought back to the standard point. The means used for adjusting this standard are very simple and ingenious. Attached to the fulcrum *F* is the lever *L*, the other end of which is connected by a pair of links with the stem of the valve *V*. Upon this lever slides the weight *W*, and we have thus a lever of the third order in which the power (the weight *W*) may be adjusted by regulating its position upon the bar *L*. The weight *W* is moved by the rod *R*, which slides through a stuffing-box so as to prevent all escape of gas

The method of using this regulator is very simple. After it has been attached to the meter and the service-pipe, so that all the gas that is used must pass through it, after passing through the meter, the burners are turned on full, and the position of the weight *W* on the bar *L* is adjusted, so as to produce a steady light without any flicker or undue pressure. When once adjusted, the apparatus may be allowed to remain constantly in this condition, and the best results, both as regards economy and amount of light will be obtained. Under ordinary circumstances, no after adjustment will be requisite; but in large establishments where the utmost economy is desired, it may be advisable to vary the standard of pressure according to those variations in the quality of the gas which occasionally take place. Moreover, in some cases, it may be desirable on special occasions to turn on the gas, even though a waste is occasioned thereby, and in such cases the change is made very easily and quickly, while at the same time it is as easy to return to the normal standard as soon as the extra demand has passed off. When it is desired to dispense entirely with the operation of the regulator, the screw *S* is turned down so as to prevent the diaphragm from rising.

Immediately beneath the letter *a* there is a small hole in the outer metallic case. Through this hole the air passes out when the diaphragm rises, and passes in when it falls. In this way the diaphragm is relieved from all outward pressure, and the pressure on the gas in the interior of the regulator will be due wholly to the weight of the diaphragm, and the movable parts connected with it. The use of this regulator precludes the necessity of any attention to the burner themselves. Every burner that is in proper order will permit the escape af exactly the proper amount of gas, and no more. The importance of this in large buildings where a great many burners are used none of the burners being under the control of any especial individual, is very obvious. Any increase of pressure in the mains, caused by the turning off of a great many burners, as occurs when the stores are closed, will be unfelt, and there will be no necessity

for any one to run to the meter to regulate the gas there, or to attempt to regulate any particular burner. Even in dwelling-houses there are always some burners in halls, passages, and elsewhere, that are away from observation, and are apt, under ordinary circumstances, to be deranged by extra pressure.

For further particulars, and those desiring to order please address the inventor, Eugene Beggs, Paterson N. J., or M. L. Callender, 42 Pine street, N. Y.

Practical Management of Gas Works.

By James R. Smedberg.

[Written expressly for this Journal.]

NUMBER XII.

ON PURIFICATION BY LIQUIDS.

With the exhauster, the process of distillation may be said to end. The coal has been exposed in close vessels to intense heat under a minimum of pressure, and the more obvious contamination of tarry and watery vapors have been largely removed by the cooling power of the condensers. The separation of the chemical impurities will complete the process of manufacture, and it is to this question of purification proper, that I now propose to turn. The field is so wide as to prevent anything like detailed investigation in a rudimentary essay, and the purpose of this last will be sufficiently accomplished by a recital of the more marked facts and theories connected with the subject.

On leaving the condensers, the gas is still unfit for lighting purposes, owing to the presence of carbonate and hydrosulphate of ammonia, free carbonic acid, and sulphuretted hydrogen. There is also usually, or always, a small quantity of tar or naphtha, which has evaded the action of the condensers; this, however, is in one way or other arrested by the various methods of attacking the impurities previously named, and does not, therefore, possess any special importance.

During the early days of gas lighting a sort of filtering vessel was employed, in conjunction with the washer, to take out any residuray tar and ammonia. The former vessel has long since fallen into disuse; and the washer, though largely and almost universally used in America, has fallen into disfavor with English engineers, who prefer the scrubber as a means of applying water or other liquids. The difficulties attending the use of these two last named forms of apparatus appear to be, that in the washer too large a volume of water is used if *complete* contact is attained, and the valuable illuminants are thus absorbed; while in the scrubber, the tar present in small quantities gradually agglutinates the dispersing material, and leaves only narrow sinuous passages through which the gas passes under such conditions of velocity and exposure as to be little benefitted. Reference will be had to these difficulties and their remedy farther on.

It is a curious fact that inventions move in cycles, and the following furnishes its proof:

The Gas mind of England has long been exercised to discover some really practical mode of purifying coal gas by liquids, and has gradually come to the conclusion that one of the by-products of the coal itself is the most efficient agent possible. Can caustic ammonia be cheaply manufactured? Can ammoniacal liquor be cheaply desulphuretted? Is it within the range of mechanics to construct a perfect scrubber? *These* are the great questions it proposes for solution.

Now the enlargement and perfecting of the functions of the scrubber, derive their importance from the fact of the strong affinity existing between sulphuretted hydrogen and ammoniacal gas, by which affinity a heavy per centage of sulphur has already been taken up in the formation of ammoniacal liquor; and we find that one mode of continuing this beautiful natural work was attempted by one Daniel Wilson in the year 1817.

Matthews's little "Compendium of Gas-Lighting," published in 1827 has the following:

> "The fact being known that sulphuretted hydrogen and ammoniacal gas will combine in certain proportions, and form a soluble mixture, occasioned its application to the purification of coal gas. To effect this, the two gases are mixed together as they are produced, and the compound afterwards passed through water. In this process the ammoniacal gas is obtained from lime saturated with ammoniacal liquor. The distillation is carried on in a separate apparatus, and the gas is collected in a large vessel, which is fixed directly over the brick-work of the fire-place. The connection between this vessel and the retorts is formed by a large pipe, through which the coal gas passes as the heat evolves it from the coal. The sulphuretted hydrogen and ammoniacal gas thus unite, and form a soluble compound, which is dissolved in passing through a large cistern of water, and the carburetted hydrogen is rendered fit for burning."

The author, in a foot note, mentions this as Wilson's patent, and adds that a subsequent patent taken out by J. F. Ledsam, for a similar proces was in use to some extent at the Birmingham and Staffordshire Gas Works.

Totally negligent of the fact that ammonia and sulphur can best be arrested simultaneously, and that the presence of the former facilitates the task of separating the latter from coal gas, Mr. Croll proposed and, to a considerable extent, introduced the washing or scrubbing of coal gas with acidulated water. In this way he took out *all* ammonia, thus rendering lime-purification from sulphur more difficult, and increasing the deposition of naphthaline in the mains by robbing the gas of what, *in small quantities* is advantageous as being the best natural solvent of this troublesome substance. The advantage of, and increased quantity of salable ammonia per ton, proved no compensation for these objections to the process, which therefore went out of use.

In 1853 Laming claimed "the purifying gas by saturating its carbonic acid with ammonia, either alone or combined with hydro-sulphuric acid, or even combined with carbonic acid, in a less quantity than it can absorb, and, after removing the resulting carbonate of ammonia, in conjunction with the further purification of the gas from free hydro sulphuric acid by any effective oxide of iron."

Laming's patent of February 3d, 1857, says, "One of the principal impurities in coal gas is carbonic acid, and it is well known that all peroxides of iron are perfectly incompetent to remove it. It is also true, that if the carbonic acid in gas could be combined with even less than a full equivalent of ammonia, it would be thereby entirely changed from a very insoluble gas into a free soluble salt, and thus be easily removable by a small quantity of water."

One important claim of this patent is the desulphurating of ammoniacal liquor by filtration through oxide of iron.

A patent was issued to Alfred Vincent Newton, acting for other parties, on March 10th, 1854, in which the inventor claims:

1st. "The purifying coal gas by introducing into it caustic ammonia, in sufficient quantity to saturate its free sulphuretted hydrogen as well as its free carbonic acid, and then removing from it all the ammoniacal compounds by washing with water.

2d. "Purifying coal gas by introducing into it caustic ammonia in sufficient quantity to convert its free carbonic acid into a salt of ammonia, washing out the ammoniacal salts, in conjunction with the removal of its free or combined sulphuretted hydrogen by means of sulphurous acid, and finally washing the gas again with water.

3d. "The mode of introducing caustic ammonia into impure gas, for its purification, by eliminating it from any mixture containing sulphate or muriate of ammonia, in retorts connected with hydraulic main or other passage for the gas."

Here we have Wilson's plan revived.

Among the claims of a patent issued Dec. 1st, 1858, to the indefatigable Laming are those for:

"Purifying gas by scrubbing or washing it, first, with raw ammoniacal liquor, finally with water, and intermediately with the mixed products of these two scrubbings or washings, subsequently to their desulphuration by any means either wholly or in part.

"Purifying gas by passing it through three or more scrubbers or washers in succession, the first being used with a solution of ammonia, sufficiently free from saturating acids, to convert both the carbonic acid and the sulphuretted hydrogen of the gas into soluble salts, and the remainder in succession, with the same portion of water, for finally washing out the ammonia and its compounds.

Leigh, in his patent of February 28th 1859, claims: "The washing of coal or cannel gas in suitable vessels with the gas-water or ammonia-water, for the purpose of removing the ammonia salts therefrom."

And in another dated March 5th, 1859, claims the use of ammoniacal liquor causticised, in whole or in part, by agitation with hydrate of lime.

In June, 1859, Laming appears again in the field with a patent which, so far as concerns our present topic of purification by scrubbing, differs little from his preceding one; and in yet another dated Nov. 26, 1863, he claims. * * * *

3d. "Preparing hydrated peroxide of iron, by combining the sulphuretted hydrogen in the ammoniacal liquors of gas works with metallic iron in small pieces, and exposing the resulting black sulphide of iron to the air to become oxidized.

4th. "Desulphuretting the ammoniacal liquor of a gas work by the action of metallic iron in small pieces, with or without the simultaneous influence of atmospheric air.

In May, 1865, Davey patented appartus for the repeated washing of gas with ammoniacal liquor.

In July of the same year, Livesey patented the desulphuration of ammoniacal liquor by blowing through it the gases of combustion from retort furnaces. These gases he took from the chimney by means of an exhauster, and applied to his purpose in a special condenser. The carbonic acid was then expelled by heat, and the purified liquor applied in a scrubber.

A patent has also been awarded for the desulphuration of the liquor by an air blast Here the patent stops, but it would be necessary to supplement this very simple process by a vessel for arresting the ammonical gas, which is driven out simultaneously with the sulphuretted hydrogen, by passing the former through water, if caustic ammonia, or through some dilute acid, if salts of ammonia be desired.

There are other patents, in which some modification or other of those cited, is embraced; but the only one important to our present purpose is the proces of F. C. Hills, in the London *Journal of Gas-Lighting* for Aug. 2d, 1870. It consists of expelling the sulphuretted hydrogen and carbonic acid from the liquor by heat, the small quantity of ammonia which passes off, being arrested by repeated passage through vessels containing unpurified liquor. A paper was read by Mr. Alfred Upward before the British Association of Gas Managers upon the subject, and may be found in the London *Journal* of the above date.*

Now it is abundantly proved by the research of patentees, chemists, and engineers, that caustic ammonia will purify gas from both carbonic acid and sulphuretted hydrogen; and it is equally certain that in the essentials of economy of apparatus and ease of manipulation, the system of purification by liquid agents is to be preferred. The difficulties in the way have been the cost of sufficiently pure ammonia, and the necessity of very intimate contact between the gas and the liquid. It was found that Laming's application of oxides of iron to the purification of gas-liquor was useless, from the very fact which he himself states in his patent of Feb. 3d, 1857, the incompetency of all peroxides of iron to remove carbonic acid. This process was introduced in the Great Central Gas Works about 12 years ago, but it never succeeded, although it would be successful for possibly half an hour at a time. "The difficulty appeared to be to bring the caustic ammonia sufficiently in contact with the gas."

All sorts of devices have been employed to increase and render permanent the surfaces to which gas is exposed in the scrubber. Grates have been recommended on which the scrubbing material is to be placed, and brick bats, broken pottery, coke, cobble-stones, drain-pipes, brush-wood, and boards, recommended for the material itself.

The conditions to be accomplished are large surface, permanent cleanliness, and as little back-pressure as possible, and Mr. Livesey, previously mentioned as a patentee, has recently adopted an arrangement which promises better results than any which have preceded it.

He uses a revolving spreader at the top of his scrubbers, while the interior is filled with quarter-inch boards on edge, between which uniform spaces are preserved of half an inch in width by means of vertical strips. His scrubber is 15 feet 6 inches in diameter by 28 feet high and in this vessel he has an exposing surface of no less thon 128,000 square feet, and yet leaves two-thirds of the space available for gas-way.

I think it may be admitted that this arrangement will entirely obviate the practical objections which have heretofore attached to the scrubber, and secure the desired results from a minimum volume of liquid.

Now, when we remember that the only remaining question is the repeated expulsion of carbonic acid and sulphur from the liquor—its *revivification*, so far as purifying power is concerned, the issue becomes narrow.

Upward says, from practical working of it, that Hills has discovered a method which is at once simpl and inexpensive, and his name stands high among British engineers. Of all the wastes about a gas-work, none is more obvious than the waste of *heat*, and there is enough of it in every one of our establishments to purify thousands of gallons of liquor, which then only requires to be lifted to the top of the scrubber by a steam pump.

* Our readers have already before them, *in extenso*, the paper of Mr. Upward, setting forth Mr. Hills's invention (see Journal of October 3, 1870)—H. W.

It is to be hoped that this simple method of liquid purification will supersede the costly, complicated, obstructive purifiers, whether for oxides or the more efficient hydrate of lime; and I trust to be able to show that caustic ammonia of sufficient purity *can* be made economically, and that it *will* completely purify coal gas. I am just entering upon experiments as to these important points and will state their results in an early number of the Journal.

Photometry as Applied to the Estimation of the Value of Coal Gas.

By Messrs. T. N. Kirkham, C. E., and W. Sugg, A. I. C. E.

[The following lecture was delivered at the meeting of the British Association of Gas Managers, held recently.]

[Continued from page 132.]

My colleague and myself had undertaken a rather long series of experiments, for the purpose of determining the relative value of the English and French standards of illuminating power, the particulars of which will be communicated to you in their proper order, and very early in our first series we were led to remark the regularity with which a Lowe's jet photometer, which was supplied with the same gas as that upon which we were experimenting, answered to every increased per centage of richer gas added to the ordinary gas we had prepared. We therefore decided, after having carried out the first series, to commence a second series, in which we used two Lowe's jet photometers, made precisely alike, and connected to and supplied with the same gas as that burned in our other photometers, which were the "cross" photometer and the Foucault photometer, both here exhibited.

In order to save confusion, we must ask you to assume for the present that which we shall doubtless amply prove to you in another part of this lecture, viz., that the system adopted by us in our experiments upon the standards of light, was the best possible to arrive at the truth.

Four operaters at the cross photometer made simultaneously an estimation of the illuminating power of the gas as compared with sperm candles, in the ordinary manner adopted by gas examiners. For better security they repeated this twice, making in all twelve experiments. Upon a diagram prepared expressly in the same manner as this one, but without the red diagonal line, was marked the average result of these 12 experiments, care being taken that the mark should be put on that lateral line corresponding to the illuminating power in candles (as found) at its intersection with that longitudinal one, corresponding to the pressure required to give a 7-inch flame, with the same gas burning in one of the Lowe's jet photometers. Thus the mark for 14-candle gas was put upon that longitudinal line marked ·63, and opposite the figure 14. The black quatrefoil is the mark. The second Lowe's jet was kept at a constant pressure, the height of the flame rising as the quality of the gas increased. This diagram shows the position of the several instruments.

Simultaneously with these experiments a fifth operator made three experiments with the Foucault photometer, which is fitted in the same manner as those employed by the municipality of Paris for the verification of the gas supplied to that city. His operations were conducted nearly in accordance with the instructions issued by the municipality as a guide to their gas examiners.

The average of these three experiments was marked on the diagram in that position, as regards illuminating power, corresponding to the value of the gas according to the French system, in the terms of the English standard candle. The red star is that mark.

A sixth operator took charge of the Lowe's jets, and observed the pressure required to give a 7 inch flame with each of the different gases examined. He also noted the time required for the consumption of ·1 of a cubic foot of such gas.

These results, we consider, clearly demonstrate the truth of our theory, for by no known law of physics can any other line be found, from an examination of these experiments, than that laid down by us.

It will be observed that there are a sufficient number of experiments of both kinds which fall on the line to justify us, without mentioning those on either side of it, which are also very conclusive.*

Erdmann's Gas-Prover.

We must now rapidly glance at the Erdmann's gas prover, and, to justify the shortness of the time which we shall devote to it, I shall take the description and opinion of its value given by Mr. Schilling, the talented director of the Munchen Gas Company, in his "Traité d'Eclairage," a work which corresponds to our own "Clegg on Gas-Lighting."

It consists of a Bunsen burner arranged in such a manner that the supply of air is admitted through a long narrow slit. A scale attached shows how far it is open, and, from the side of this aperture, it is sought to establish the rate of the passage of air demanded for the perfect oxidation of the gas burning at the top of the burner; and from this, according to the theory before mentioned, that the richer the gas the greater the quantity of air required for its perfect combustion, to determine the illuminating power of the gas.

Mr. Schilling considers that the instrument requires meters or other apparatus to measure exactly the quantity of air and gas burned together, in order that its indications may be of any value whatever, and, from a number of carefully conducted experiments published by him—which, if time had allowed, I should have been pleased to place before you—he demonstrates that it is not at present a reliable instrument.

Mr. Friedleben, of Frankfort-on-Maine, has in his gasograph remedied in theory some of those defects, although his instrument has not within itself those elements of precision which are demanded by self-photometers such as these. The instrument is here at work, and it consists of a revolving vertical dial, which turns on its axis once in twelve hours. A very small meter in the interior gives motion to a piece of apparatus, by which at every revolution a hole is punctured in the paper. The number of points per hour bear relation to the illuminating value of the gas.

A very pretty little instrument, a modification of Erdmann's gas-prover, was exhibited at the Exhibition of 1862, by Mr. S. Elster, of Berlin, which certainly amended all the faults in the original invention. It consisted of a small gasholder, with a very beautifully made and large scale attached to it. The contents of the gasholder were about half a tenth of a cubic foot. Into this gasholder was admitted a quantity of gas, and the rest of the holder was filled with air. At the base of the holder, and connected thereto by means of a short tube, was fixed a burner with a number of holes, somewhat in form resembling the rose of a very small watering-pot. The gas and air was allowed to burn in this burner at a certain height, when, if it was perfectly oxidized, and burned with a perfectly blue flame, the quantity of air which had been admitted to the holder was taken to represent, by comparison with a specially prepared table, the illuminating power of the gas; if, on the contrary, the gas burned with a white tip, or was too much oxidized, the gasholder was emptied, and the trial repeated till the result of complete oxidation was obtained.

This may be termed a tentative process, and I took the liberty, in conversation with Mr. Elster, to observe to him that however good it might be, it was an instrument requiring great care on the part of the operator—a mistake might result in an experiment upon the explosive force of certain mixtures of gas and air of a very unsatisfactory nature to the operator—but he could not see it. Probably German operators never make a mistake, or are too absorbed in their scientific experiments to let the thoroughness of their investigations be interfered with by their personal inconvenience. Nevertheless, if this system of burning the gas with air be of any use to us, this method seems to be the right way of employing it.

The duration test is said by some to have originated with Dr. Fyfe, but this is not substantiated that we are aware of. The very idea, however, bears the stamp of a shrewd North Briton. It is still founded on the theory that the richest gas contains the most carbon, but we have no mention of a chemical analysis to find how much carbon there is in it, but this shrewd practical question—How long will it burn? And so we have this theory altered thus: Issuing from a constant orifice at a constant pressure, the *richest* gas will burn the longest time. This is, in fact, the true application of all photometrical tests, for to the consumer the advantage of an increase of illuminating power means, or should mean, a reduction of the quantity of gas required to light his house with the same amount of light he enjoyed before the alteration.

Careful examination of the theory shows, however, a radical defect in it, which exercises a very important effect upon the test, as well as upon the commercial result.

It is not practically true that richer gas issuing from a constant aperture, at a constant pressure, will burn longer than a poorer gas. Theoretically it will, but the difference between the richer and the poorer gases is so small that it is difficult to tell one from the other. Thus, a jet of 12-candle gas, burning on a jet photometer at a pressure of 6-10ths of an inch, consumed two cubic feet of gas in one hour. A jet of cannel gas, equal to 23 candles illuminating power, burning on the same instrument under exactly the same circumstances, consumed 1 9 cubic foot. At first sight this sounds anomalous, and you will naturally ask, "Then what is the difference between the two? And what advantage is it, then, to burn cannel gas?" Doubtless, to many of you these questions are as familiar as possible. Consumers are constantly asking them. The difference in the two jets is in the length of the flame. With the 12-candle gas we get, perhaps, a 7-inch, and with the 23-candle gas we get a 9 or 10-inch flame. One more element must then be taken into consideration, and that is the height of the flame, and the theory must be altered as follows: Burning from an aperture of fixed dimensions, a richer gas will supply a flame of a constant height for a longer period than will a poorer gas. It necessarily follows that a lesser pressure is required for the richer gas than for the poorer. Thus with poor gas we have a 7-inch flame at ·685, while with 22-candle gas we have a 7-inch flame with ·40 pressure.

These flames consume respectively 1-10th of a foot of gas—the 12-candle gas in 2 min 46 sec., or a little over 2 cubic foot per hour; the 22-candle gas in 4 min. 12 sec., or 1·45 cubic foot per hour. The difference between the two is 55-100ths of a foot of gas per hour, or at the rate of 5·5-100ths of a cubic foot of gas per candle, if the decrease per candle is in direct proportion, which you will perceive it is not; but this is near enough for the purposes of explanation. It has therefore appeared to my colleague and myself that the duration test may be employed in conjunction with the jet photometer in three ways, either of which may be made self-registering, and may be attached to any jet photometer fitted upon our new system. Thus an apparatus similar to the one here exhibited, which is simply this: A flat paper dial is made to revolve by means of an eight-day clock, with a heavy 40-inch pendulum. An electro-magnet with an armature is fixed at one side of it, and the circuit of a current of electricity is completed through it every time the meter here completes one revolution, which is equal to 1-10th of a cubic foot. The armature is thereby attracted to the face of the magnet, and in jumping to it punches a hole in the paper by means of the point fixed to one end of it. Thus we should have 14·5 points in one hour with 22-candle gas, and 20·5 points with 12-candle gas, or ·6 of a point per candle.

Another instrument (which is here shown) for the same purpose works in this manner: An eight-day clock, with a 40-inch pendulum, is made to wind off a a strip of paper from one wheel to another at the rate of about two inches per minute. A meter is made which, by a simple touch arrangement, completes the circuit of a current of electricity through an electro-magnet every time the 100th of a foot of gas passes along. Another electro magnet punches a hole in the middle of the paper every minute, while a third does the same thing every hour. Thus, as before, for 22-candle gas we should find 10 points in 4 min. 12 sec., or 145 points in an hour, and with 12-candle gas we should find 10 points in 2 min. 46 sec., or 204 points in an hour. One is a slow instrument, and the other a quick one. The difference between the two is this, that while the slow instrument gives good practical results in an hour, and is sufficient for most manufacturing purposes, the quick one, which is more carefully constructed, will show the illuminating power of the gas in five minutes at most.

The third method of using the duration test is by attaching the meter registering tenths of a foot of gas to the latter mentioned clock apparatus, and the result obtained on the paper will be the number of minutes and parts of a minute that a flame of seven inches will be maintained with a tenth of a foot of gas. From such data the illuminating power of that gas may be ascertained by a reference to the diagram. For example, it is found that a 7-inch flame has been maintained in the jet photometer for 3 min. 20 sec. by the consumption of 1-10th of a foot of gas, Question: What is the illuminating power of such gas? Answer: Referring to the diagram, we find, opposite the lateral line, 3 min. 20 sec., a little over 16-point 9-candle gas. Such a quality gas will do this, and no other.

Now to show how the jet photometer and duration test are combined in practice. We will suppose that we have a gas under examination which gives a 7-inch flame at 5-point 6-10ths pressure. Referring to the diagram headed "Retrograde Scale," we find that the longitudinal line corresponding to 5-point 6-10ths cuts the red diagonal line on the sixth lateral line between 16 and 17 candles; the value of the gas is therefore 16·6 candles.

The corresponding duration test is found by referring to that part of the jet photometer diagram headed "Duration Test." Finding the longitudinal line corresponding to 5-point 6-10ths pressure, we follow it up till it cuts the red line. This we find it does at that lateral line corresponding to 3 min. 17 sec., which is the time a tenth of a foot of such gas ought to last. If the slow-registering apparatus is used, we should find 17 points on the paper in one hour; or, if the quick instrument is used, 172 points in one hour; or, on the third system, 1 point every 3 min. 17 sec.

But none of these self instruments, however good they may be in themselves, are of any practical value to us, unless their indications can be compared with the standard adopted by the British Parliament, as a point of comparison from which to deduce the value of gas supplied to the public, and which is inserted in all Acts of Parliament relating to gas. That standard is a sperm candle of six to the pound, burning at the rate of 120 grains per hour. Naturally nothing can be more easy of comprehension to the British public than this, that a burner consuming 5 cubic feet of gas per hour shall give a light equal to a certain number of sperm candles.

[To be continued.]

* An enlarged colored diagram of these experiments is published for the use of operators testing with Lowe's jet photometers.

The Chemical History of a Candle.

BY PROFESSOR FARADAY.

[A course of Six Lectures delivered before the ROYAL INSTITUTION of Great Britain.]

LECTURE IV.

[Continued from page 101, No. 8.]

PRODUCTS: WATER FROM THE COMBUSTION—NATURE OF WATER—A COMPOUND—HYDROGEN.

Think of all its qualities—the light gas which stood well in inverted vessels, burning with a pale flame at the mouth of the jar, and see whether this gas does not satisfy all these conditions. If it be hydrogen, it will remain here while I hold this jar inverted. [A light was then applied, and the hydrogen burned.] What is there now in the other jar? You know that the two together made an explosive mixture. But what can this be which we find as the other constituent in water, and which must, therefore, be that substance which made the hydrogen burn? We know that the water we put into the vessel consisted of the two things together. We find one of these is hydrogen; what must the other be which was in the water before the experiment, and which we have now by itself? I am about to put this lighted splinter of wood into the gas. The gas itself will not burn, but it will make the splinter of wood burn. [The lecturer ignited the end of the wood and introduced it into the jar of gas.] See how it invigorates the combustion of the wood, and how it makes it burn far better than the air would make it burn, and now you see by itself that every other substance which is contained in the water, and which, when the water was formed by the burning of the candle must have been taken from the atmosphere. What shall we call it, A, B, or C. Let us call it O—call it "oxygen;" it is a very good distinct-sounding name. This, then, is the oxygen that was present in the water, forming so large a part of it.

We shall now begin to understand more clearly our experiments and researches; because when we have examined these things once or twice we shall soon see why a candle burns in the air. When we have in this way analyzed the water—that is to say, separated or electrolyzed its parts out of it—we got two volumes of hydrogen and one of the body that burns it. And these

1 Hydrogen.	8 Oxygen.	Oxygen.....	88.9
		Hydrogen.....	11.1
	9	Water.....	100.0

two are represented to us on this diagram, with their weights also stated, and we shall find that oxygen is a very heavy body by comparison with the hydrogen. It is the other element in water.

I had better, perhaps, tell you now how we get this oxygen abundantly, having shown you how we can separate it from the water. Oxygen, as you will immediately imagine, exists in the atmosphere; for how should the candle burn to produce water without it? Such a thing would be absolutely impossible, and chemically impossible without oxygen. Can we get it from the air? Well, there are some very complicated and difficult processes by which we can get it from the air; but we have better processes. There is a substance called the black oxyd of manganese; it is a very black looking mineral, but very useful, and when made red hot it gives out oxygen. Here is an iron bottle which has had some of this substance put into it, and there is a tube fixed to it, and a fire ready made, and Mr. Anderson will put that retort into the fire, for it is made of iron and can stand the heat. Here is a salt called chlorate of potassa, which is now made in large quantities for bleaching, and chemical and medical uses, and for gunpowder and other purposes. I will take some and mix it with some of the oxyd of manganese (oxyd of copper or oxyd of iron would do as well), and if I put them in a retort, far less than a red heat is sufficient to evolve this oxygen from the mixture. I am not preparing to make much, because we only want sufficient for our experiments; only, as you will see immediately, if I use too small a charge, the first portion of the gas will be mixed with the air already in the retort, and I should be obliged to sacrifice the first portion of the gas because it would be so much diluted with air; the first portion must therefore be thrown away. You will find in this case that a common spirit lamp is quite sufficient for me to get the oxygen, and so we shall have two processes going on for its preparation. See how freely the gas is coming over from that small portion of the mixture. We will examine it and see what are its properties. Now, in this way, we are producing, as you will observe, a gas just like the one we had in the experiment with the battery, transparent, undissolved by water, and presenting the ordinary visible properties of the atmosphere. (As this first jar contains the air together with the first portions of the oxygen set free during the preparation, we will carry it out of the way, and be prepared to make our experiments in a regular, dignified manner.) And inasmuch as that power of making wood, wax, or other things burn, we so marked in the oxygen was obtained by means of the voltaic battery from water, we may expect to find the same property here. We will try it. You see there is the combustion of a lighted taper in air, and here is its combustion in this gas [lowering the taper into the jar]. See how brightly and how beautifully it burns—you can also see more than this—you will perceive it is a heavy gas, whilst the hydrogen would go up like a balloon, when not encumbered with the weight of the envelope. You may easily see that although we obtained from water twice as much in volume of the hydrogen, as of oxygen, it does not follow that we have twice as much in weight; because one is heavy and the other a very light gas. We have means of weighing gases or air; but without stopping to explain that, let me just tell you what their respective weights are. The weight of a pint of hydrogen is three-quarters of a grain; the weight of the same quantity of oxygen is nearly twelve grains. This is a very great difference. The weight of a cubic foot of hydrogen is one-twelfth of an ounce; and the weight of a cubic foot of oxygen is one ounce and a third. And so on, we might come to masses of matter which may be weighed in the balance, and which we can take account of as to hundredweights and as to tons, as you will see almost immediately.

Now, as regards this very property of oxygen supporting combustion, which we may compare to air, I will take a piece of candle to show it you in a rough way, and the result will be rough. There is our candle burning in the air; how will it burn in oxygen? I have here a jar of this gas, and I am about to put it over the candle for you to compare the action of this gas with that of the air. Why, look at it; it looks something like the light you saw at the poles of the voltaic battery. Think how vigorous that action must be! And yet during all that action nothing more is produced than what is produced by the burning of the candle in air. We have the same production of water; and the same phenomena exactly, when we use this gas instead of air, as we have when the candle is burnt in air.

But now we have got a knowledge of this new substance, we can look at it a little more distinctly, in order to satisfy ourselves that we have got a good general understanding of this part of the product of a candle. It is wonderful, you see, how great the supporting powers of this substance are as regards combustion. For instance, here is a lamp which, simple though it be, is the original, I may say, of a great variety of lamps which are constructed for divers purposes—for lighthouses, microscopic illuminations, and other uses; and if it was proposed to make it burn very brightly, you would say, "If a candle burnt better in oxygen, will not a lamp do the same?" Why, it will do so. Mr. Anderson will give me a tube coming from our oxygen reservoir, and I am about to apply it to this flame, which I will previously make burn badly on purpose. There comes the oxygen; what a combustion that makes! But if I shut it off, what becomes of the lamp? [The flow of oxygen was stopped, and the lamp relapsed to its former dimness.] It is wonderful how by means of oxygen, we get combustion accelerated. But it does not affect merely the combustion of hydrogen, or carbon, or the candle; but it exalts all combustion of the common kind. We will take one which relates to iron, for instance, as you have already seen iron burn a little in the atmosphere. Here is a jar of oxygen, and this is a piece of iron wire; but if it were a bar as thick as my wrist, it would burn the same. I first attach a little piece of wood to the iron, I then set the wood on fire, and let them both down together in the jar. The wood is now alight, and there it burns as wood should burn in oxygen; but it will soon communicate its combustion to the iron. The iron is now burning brilliantly, and will continue so for a long time. As long as we supply oxygen, so long can we carry on the combustion of the iron, until the latter is consumed.

We will now put that on one side, and take some other substance; but we must limit our experiments, for we have not time to spare for all the illustrations you would have a right to, if we had more time. We will take a piece of sulphur: you know sulphur burns in the air; well, we will put it into the oxygen, and you will see that whatever can burn in the air can burn with a far greater intensity in oxygen, leading you to think that perhaps the atmosphere itself owes all its power of combustion to this gas. The sulphur is now burning very quietly in the oxygen; but you cannot for a moment mistake the very high and increased action which takes place when it is so burned, instead of being burned merely in common air.

I am now about to show you the combustion of another substance—phosphorus. I can do it better for you here than you can do it at home. This is a very combustible substance, and if it be so combustible in air, what might you expect it would be in oxygen? I am about to show it to you not in its fullest intensity, for if I did so, we should almost blow the apparatus up; I may even now crack the jar, though I do not want to break things carelessly. You see how it burns in the air. But what a glorious light it gives out when I introduce it into oxygen! [Introducing the lighted phosphorus into the jar of oxygen.] There you see the old solid particles going off which cause that combustion to be so brilliantly luminous.

Thus far we have tested this power of oxygen and the high combustion, it produces, by means of other substances, We must now, for a little while longer, look at it as respects the hydrogen. You know that when we allowed the oxygen and the hydrogen derived from the water to mix and burn together, we had a little explosion. You remember also that when I burnt the oxygen and hydrogen in a jet together, we got very little light but great heat; I am now about to set fire to oxygen and hydrogen mixed in the proportion in which they occur in water. Here is a vessel containing one volume of oxygen and two volumes of hydrogen. This mixture is exactly of the same nature as the gas we just now obtained from the voltaic battery; it would be far too much to burn at once; I have therefore arranged to blow soap bubbles with it, and burn those bubbles, that we may see by a general experiment or two how this oxygen supports the combustion of hydrogen. First of all we will see whether we can blow a bubble. Well, there goes the gas [causing it to issue through a tobacco pipe stem into some soap suds.] Here I have a bubble. I am receiving them on my hand, and you will perhaps think I am acting oddly in this experiment, but it is to show you that we must not always trust to noise and sounds, but rather to real facts. [Exploding a bubble on the palm of his hand.] I am afraid to fire a bubble from the end of the pipe, because the explosion would pass up into the jar and blow it to pieces. This oxygen will then unite with the hydrogen, as you see by the phenomena and hear by the sound, with the utmost readiness of action, and all its powers are then taken up in its neutralization of the qualities of the hydrogen.

So now I think you will perceive the whole history of water with reference to oxygen and the air, from what we have before said. Why does a piece of potassium decompose water? Because it finds oxygen in the water. What is set free when I put in the water, as I am about to do again? It sets free hydrogen and the hydrogen burns; but the potassium itself combines with oxygen; and this piece of potassium, in taking the water apart—the water, you may say, derived from the combustion of the candle—takes away the oxygen which the candle took from the air, and so sets the hydrogen free; and even if I take a piece of ice, and put a piece of potasssum upon it, the beautiful affinities by which the oxygen and hydrogen are related are such that the ice will absolutely fire to the potassium. I show this to you to-day, in order to enlarge your ideas of these things, and that you may see how greatly results are modified by circumstances. There is the potassium on the ice, producing a sort of volcanic action.

It will be my place, when next we meet, having pointed out these anomalous actions, to show you that none of these extra and strange effects are met with by us—that none of these strange and injurious actions take place when we are burning, not merely a candle, but gas in our streets, or fuel in our fireplaces so long as we confine ourselves within the laws that nature has made for our guidance.

Crystal Palace District Gas Company, Lower Sydenham, Kent, S. E.

[We publish the following report in full, as an example of the prosperous condition of gas manufacture, not only with this company, but in England.—EDS.]

Report of the directors for the half year ending 30th June, 1870, presented to the shareholders at the ordinary general meeting on the 29th September, 1870:

The directors have to report that the business and progress of the company have been satisfactory during the half year. The price of coal has been higher, but the coke and other products have realized more than those of the corresponding half of the previous year. Notwithstanding the reduction in the price of gas, it will be seen that the rental has considerably increased.

The reports of the chemical adviser of the company and of the medical officers of the parishes supplied by the company, on the purity and illuminating power of the gas, continue to be satisfactory. During the half year, twenty-three visits have been made to the works (without notice) by Dr. Letheby on the part of the company, and Dr. Puckle and Dr. Bernays on behalf of the parishes of Lambeth and Croydon respectively; and the average result of these examinations of the gas of the company has given an illuminating power of 15·18 standard sperm candles.

The gasholder, reported upon at the last meeting, is progressing to the satisfaction of the engineer.

The balance sheet for the half year, to the 30th June last—appended to this report—shows the financial position of the company. The profit for the half year is £6,223 17s. 5d., which, together with £130 15s. 11d., the unappropriated profit of the preceding half year, makes the available balance £6,354 13s. 4d. Out of this sum the directors recommend the declaration of a dividend at the rate of 6 per cent. per annum on the preference capital; a dividend at the rate of 7 per cent. per annum on the ordinary 7 per cent. capital; and a dividend at the rate of 10 per cent. per annum on the original capital; all free from income tax. They also recommend that, out of the balance, the sum of £250 be written off preliminary expenses; and that the balance of £76 13s. 3d. be carried forward to the profit of the succeeding half year.

(By order of the Board.)
ERASMUS WILSON, Chairman.

Profit and Loss, half year ending June 30, 1870.

Dr.	£.	s.	d.
To amount of coals carbonized	9,421	19	5
lime, oxide and labor	191	15	3
trade charges	1,436	13	3
horses and carts	29	16	6
mains renewal account	174	18	1
works renewal account	913	6	7
meters renewal and repairs account	548	3	2
rent, rates, and taxes	755	1	6
directors' and auditors' fees	530	0	0
salaries and collectors' commission	1,420	4	6
wages	2,819	10	3
interest on loans	440	16	2
bad debts and allowances on collection	200	6	6
law charges	2	12	6
retort accounts	500	0	0
contingent fund	2,301	7	10
profit	6,220	12	5
	£27,907	8	17

Cr.			£.	s.	d.
By private rental, lady-day quarter	12,937	14	11		
public " " "	1,257	2	11		
private rental, midsummer quarter	6,274	8	4		
public " " "	1,198	9	5		
			21,667	15	7
meter rental			855	10	2
coke made for sale	4,604	15	0		
breeze ditto	74	14	0		
tar ditto	373	9	7		
sundries	2	7	8		
			5,054	6	3
sulphate of ammonia, net profit			799	11	11
			£27,907	8	11

Balance Sheet, 30th June, 1870.

Dr.			£.	s.	d.
To proprietors for paid-up capital:—					
5,000 preference shares, at £10 per share			50,000	0	0
5,000 original shares, at £10 per share			50,000	0	0
10,000 ordinary seven per cent. shares, at £10 per share	£100,000	0 0			
less amount uncalled	42,057	0 0			
			57,943	0	0
loans on debenture			16,550	0	0
amount due to sundry persons			7,154	19	9
contingent fund, uninvested	1,568	18 2			
" " invested	134	14 0			
appropriated from profit and loss for contingent fund	2,301	7 10			
			4,000	0	0
profit unappropriated			130	15	11
profit and loss			6,220	12	5
			£191,999	8	1

Cr.	£.	s.	d.
By amount for plant, etc	157,500	9	8
freehold land	8,836	17	8
preliminary expenses	3,000	0	0
retort account	698	18	8
stock on hand	6,678	17	0
amount due from sundry persons	844	19	9
invested in consols from contingent fund	134	14	0
private gas and meter rental, midsummer qr.	6,253	4	7
arrears	463	19	1
public rental, midsummer quarter	1,198	9	5
fittings	1	0	9
balance at bankers	6,338	2	6
	£191,999	8	1

Examined and confirmed, August 26, 1870. JOHN GRAY, WM. PURVIS, } Auditors.

Appropriation of Balance.

	£.	s.	d.
Balance brought forward from last account	130	15	11
Balance of profit and loss	6,220	12	5
	£6,351	8	4

Dividend on preference share capital, at 6 per cent	1,500	0	0		
Dividend on ordinary 7 per cent. capital, at 7 per cent	2,728	0	1		
Dividend on original share capital, at 10 per cent	2,500	0	0		
				6,028	0 1
Preliminary expenses, to be written off				250	0 0
Balance to be carried to next account				73	8 3
				£6,351	8 4

(By order of the Board)
Sept. 2, 1870. ERASMUS WILSON, Chairman.

An Explosion of a boiler recently in the Hoboken Gas Works, destroyed the interior of the building, and knocked out the end walls. The damage is estimated at about $5,000.

What is the Market for Peat Fuel?

We take the following from a pamphlet published by T. H. Leavitt of Boston, entitled "Peat Fuel; How to Make it, and How to Use it":

In all manufacturing or producing busines, the question of *demand* is full as important as the matter of *supply*, and among those to whom the subject of *cheap fuel* comes for the first time, as a matter to be considered, the inquiry is not unfrequently made, "Can it be sold?" A moment's reflection, in most cases, brings about as prompt a reply as the Irishman's question, "Would a duck swim?"

Now every family, every place of business—be it office, store, or workshop—every manufacturing establishment, and every railroad in the land, are consumers of fuel; in fact, every man we meet is a purchaser of fuel in same shape; some on a small scale, but very many on not only a large scale, but very many on not only a large scale, but in quantities that are simply immense. Moreover, in some of our heaviest establishments it is the prime article of necessity, the mainstay of the business, the basis of power; without it manufacturing enterprise would be impotent of action, and transportation, another great necessity of all mercantile and commercial transactions, would fail, both by sea and by land.

It is a fact, too, that in one article of common necessity, not even the bread we eat, is the quality and price co closely scrutinized and carefully considered by every purchaser, large and small, as in the article of fuel.

Without attempting to discuss the matter here, it is sufficient to say, that the brief statements given in these pages, from reliable authorities, show that *peat fuel*, properly prepared, is a *good fuel*, superior even, in many respects, for many purposes, to either coal or wood.

It is also shown, with equal clearness, that it exists in immense quantities, and can be manufactured and produced at very small cost, as compared with either coal or wood.

In other words, it is a *good cheap fuel*. This being the case, the natural result hardly need be stated, for a *good* article, of common necessity, when offered *low, commands a* sale. *The people*, when once made aware of these facts, *will buy it*.

And it is not too much to say, that in any place where it is produced, the *demand* will, for many years, be likely to *exceed* the supply; which will certainly be considered a healthy condition of things for producers of the fuel.

Among extracts from correspondence, on previous pages, will be observed quite a number of instances where the demand for this fuel, in large quantities, is distinctly stated, the fact of its value for the purposes required being now past question.

They are given here only as illustrating a very large number of cases of similar character, which are constantly coming to our notice by direct correspondence; while within the circle of our own personal acquaintance the cases are numerous of heavy concerns, who would be purchasers of hundreds and thousands of tons of peat fuel, at handsomely paying rates (and still consider it *cheap*) the moment they could be assured of a steady and constant supply.

The demand for this fuel for domestic purposes, on similar grounds is equally apparent.

The Cochituate Water Works.

AN EVENT IN THE HISTORY OF THE CITY OF BOSTON.

The Boston *Advertiser*, of the 26th October, says:

"No elaborate ceremony marked the formal opening of the Chestnut Hill reservoir yesterday, and yet the event was an important one in the history of Boston. It is almost twenty-five years since the city obtained permission to supply itself with water from Lake Cochituate, and it was twenty-two years yesterday since the incomplete water works were dedicated, in presence of a great concourse of the people, by turning the water upon the fountain on the Common. In the course of the following year, the several reservoirs in the city proper at South and East Boston, and in Brookline, were finished and put to their appropriate use, when it was supposed that the supply and means of storage were ample to meet all probable demands for a great many years. But the growth of the city, the danger that a break somewhere might cut off, temporarily, the whole supply, the necessity of saving all the water by an increase of storage capacity, and for equalizing the pressure of the water on the vast area to be supplied, have led irresistibly to the construction of the magnificent new reservoir. It has been five years in course of preparation for the reception of water, and the upper basin having been formally opened two years ago, on what may be called the water anniversary of the city, the lower and larger basin was yesterday put to its designed use.

"We need not parade a mass of figures to show the capacity, the strength, and the cost of this work. It is sufficient to say that the money has been well expended, and that the reservoir has been thoroughly constructed, and that there can henceforth be no danger of a failure of our water supply, except by a combination of circumstances too improbable to be noticed. Mr. Bradlee, and his honor the Mayor, both hinted that the water-works system of Boston is by no means complete. But it is evident that the next move must be to increase the source of original supply. The growth of the city, both in population and in territory, will necessitate an addition to the lake surface now drawn upon, at no distant day. But the problem is an easy one in comparison with that which engaged the attention of our fathers. With them it was an effort to overcome prejudices which no one now entertains. For us it to to seek out new ways of increasing and saving the supply. The Boston of 1846 wisely prepared for the Boston of 1870. The Boston of to-day must make preparations for the city that will, twenty years hence, stretch to the farther limits of the new reservoir, and include a population greatly exceeding that which now covers the same territory. No appropriations are more willingly voted than those made with a view to increase the regular daily supply of the great cleansing and health-giving element, and the same alacrity will be manifested in the future."

Iron Ore Found in Lima.

About two weeks since, E. P. Brooks, Esq. of Elmira—Superintendent of the Rochester Natural Gas-Light Co.—while superintending a party of surveyors who have been locating a route for a pipe to convey the gas from the Bloomfield Well to this villiage, picked up what he thought was a peculiar looking stone. This he took to a scientific gentleman of Elmira, and it was prononnced by him to be bog ore, of the species from which Bessemer steel is made. The purity of the specimen is estimated at 70 per cent. pure iron. Mr. Brooks was in town last Saturday and secured a larger piece. He proposes to take it to the smelting furnace in Elmira, and have the exact percentage of iron ascertained. The lumps were found in the south-east part of this town, on the west side of Honeoye Creek. Our reporter has visited the vicinity and reports that the ore is to be found in considerable quantities, having been thrown out by the plow. One farmer says that his plow has run along upon the ore for several rods in succession, it being only a few inches below the surface. It makes its appearance on the farms of N. Gary, A. A. Terry, and several others adjoining those above named. Large piles of the ore have lain in the corners of the fences for years, no one supposing it to be of any value.

Mr. Brooks says that if the ore is as pure as present indications warrant—and he seems to have no doubt of it—it will be worth $5 per ton delivered at the furnace. Also, that if there can be 1,000 tons of the ore found, it will pay to erect a smelting furnace to work it up. The ore is found only two miles from the Bloomfield Gas Well. Thus it would seem that nature has furnished all that is necessary to make a large establishment in our very midst. The above named company represent a large amount of capital, so that the enterprise will be insured if the ore is of value. Future developments will be anxiously looked for by all our residents.—*Lima Recorder, Oct. 20, 1870.*

Columbia College Alumni Association—The annual meeting of the Alumni Association of Columbia College was held Oct. 3d. After a report on the condition of the College and Association the past year, and the necrology had been read, the election for officers was held. Henry James Anderson, M. D., LL. D., of the class of 1816, was elected president: Frederick De Peyster, LL. D., of the class of 1816, vice-president; Gratz Nathan, A. M., of the class of 1861, secretary; Charles B. Swords, of the class of 1829, treasurer. The following gentlemen were appointed a standing committee for the ensuing year: Wm. Mitchell, LL.D; Henry Drisler, LL.D.; James Emmott, George Payne Quackenboss, Jeremiah Loder, Chas. A. Silliman, John P. Kernochan, Stewart L. Woodford, J. Howard Van Amringe, George P. Smith, Robert L. Belknap, Cadwallader D. Ogden.

The Bloomfield Natural Gas Company have advertised in the Elmira papers for proposals to dig the trench for laying pipes from the well to the villiage of Lima, seven miles distant, the work to be completed by the middle of November. Mr. Brooks, the superintendent, last week took deeds of the farmers along the proposed route, and it looks now as though they were to have gas in Lima soon. So mote it be.

Correspondence.

[Correspondents in all cases should sign their communications with their names and address in full, not necessarily for publication, but as a guarantee of good faith.—Eds.]

On the Freezing of Exposed Mains.

TIFFIN, OHIO, November 2, 1870.

Messrs. Editors: In your issue of October 17th is the reply of Brother Hulett to Brother Harris of Mansfield, on the prevention of exposed mains from freezing; his contrivance will be quite effective. I have also experienced quite as serious a difficulty in crossing the Sandusky River, but am quite satisfied with a much more simple method. Let us fairly consider this important question. I appeal to the experience of Brother Hulett and others to decide *where* Jack Frost closes up a pipe. I think it will be found at the point where the pipe *leaves* the ground. In gas post, service, and main, I have *always* found it so.

There is no question that a downy film of frost will form in an exposed pipe, sufficient to impede the flow, but, I think, never to *stop* it; and I question whether such formation would take place sufficient to attract notice, if *otherwise* unobstructed. My theory is this; the condensation following the gentle inclination of the pipe, trickles along until it comes to that part of the pipe embraced by the frozen earth; at that point it *freezes solid*, so solid that I have sometimes failed with an iron rod to make a hole through it. Now for the remedy; I assert that *any* means which prevent the contact of earth and pipe will be successful.

In the case of lamp posts I clear all the dirt out of the post, and substitute straw, or tan bark, or wood shavings; I prefer the latter. In the case of services, cut round the service at the point indicated and stuff with woolen rags, and in the case of mains, if Brother Hulett had only four or five feet of the wrought iron casings at each end, I am clearly of opinion the effect would have been the same. The pipe on the bridge now stands four feet above the roadway, *fully* exposed to the west winds sweeping the river, but has not given me a moments trouble since it was fixed, as I will now describe.

The earth was cleared away all round it at the point of contact with the earth, and a wooden box (no ends) placed around it, and stuffed with straw; nothing more need to be done than keep two or three inches of straw around it, *at that point*. This same pipe had for years been boxed up in manure, etc., its full length, and as sure as the winter come the trouble of its freezing followed.

I have just given up my connection with gas operations, but feel sufficiently interested to add my moiety of experience.

In the matter of benzine for wet meters the idea occurred to me three years ago, and I concluded to try it, but I took the precaution to do so where I could observe the effects, viz., in my station meter. I found the benzine carried very rapidly from the meter to the drips in the dry well, where I pumped it out, and had to fall back on aqua pura. Yours truly,

MACHINIST.

[The correspondence above is by a well known Gas Engineer of the West, and embodies several items of additional information in regard to methods of preventing gas pipes from becoming obstructed with frost. It affords us pleasure to give room to any correspondence that will in any wise benefit the fraternity.—Eds.]

Recent American Patents.

Pertaining to the Specialties of this Journal, for the two weeks ending November 12, 1870.

108,554.—Steam Pump.—G. F. Blake, Boston, Mass. Antedated Oct. 20, 1870.

108,574.—Combined Steam and Gas Engine.—J. A. H. Ellis, Springfield, Vt.

108,576.—Steam Engine.—Philip Estes, Leavenworth, Kansas.

108,579.—Gas Burner.—C. S. Ford (assignor to Chas. Young), Philadelphia, Pa.

108,583.—Gas Heater.—Richard George Kilburn, England.

108,604.—Steam Generator.—Truckson S. La France, Elmira, N. Y.

198,618.—Low-Water Indicator.—A. F. W. Neynaber, Philadelphia, Pa. Antedated Oct. 20, 1870.

108,703.—Sectional Steam Generator.—John Griffith, and G. W. Wundram, New York city.

108,757.—Water Wheel.—Joel T. Case, New Hartford, Conn.

108,828.—Low-water Indicator.—Frederick Raynsford, assignor to himself and C. L. Bouchard, Grand Rapids, Mich.

108,894.—Carbureting Attachment for Gas Burners.—J. H. Steiner, Reading, assignor to himself and Christian Sharps, Philadelphia, Pa.

108,888.—Gas Heater.—S. C. Dare, New York city.

108,904.—Pressure-Regulator for Water and Steam Apparatus.—John C. Hagan, Nashville, Tenn.

108,905.—Steam and Water Supply and Pressure-Regulator.—J. C. Hagan, Nashville, Tenn.

108,935.—Steam Generator.—John T. Rich, Philadelphia, Pa.

108,937.—Gas Apparatus.—J. E. Richard, assignor to himself and E. C. Plumer, Columbia, S. C.

REISSUES.

4,168.—Manufacture of Gas from Hydrocarbons.—Joshua Kidd, New York city.—Patent No. 106,699, dated August 23, 1870: patented in England Jan. 5, 1864.

RECENT ENGLISH PATENTS.

[From the LONDON ARTISAN, Nov. 1. 1870.]

2591.—Gas.—G. Symes.

2608.—Utilising the Heat of Steam &c.—W. R. M. Thomson.

2622.—Fuel.—T. Clemetson and J. Deere.

2623.—Improved Hydrometer.—E. Leach.

2657.—Direct Acting Steam Engines.—H. Vosper.

2664.—Revivifying the Materials Used for the Purification of Gas.—A. McNeil and W. Wheaton.

2670.—Condensing the Smoke and Products of Combustion.—A. S. Rake.

2678.—Steam Engines.—W. R. Lake.

2684.—Single Cylinder Steam or other Motive Power Engines.—J. Shand.

2710.—Improvements in Double Acting Pumps.—J. Bain.

2730.—Gas Stoves for Heating and Warming Rooms.—J. Stalvies.

2771.—Water-Heating Apparatus.—J. Russell.

Smedberg's "Synopsis of British Gas-Lighting."

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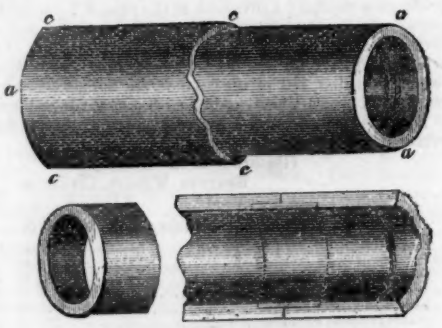

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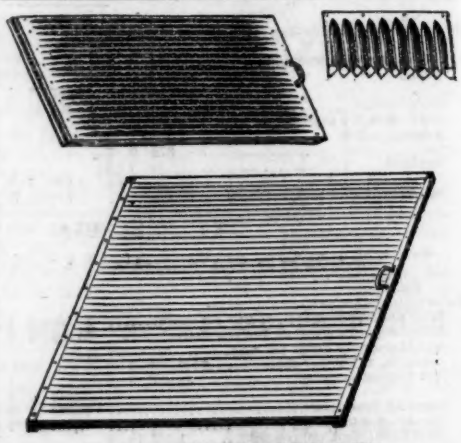

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[NOTE BY PROFESSOR WURTZ.—Contributions and items for which I am, as a Scientist, individually responsible, will have attached my full name or initials.—H. W.]

WEDNESDAY, NOVEMBER 16, 1870.

WISHING TO MAKE this Journal an organ of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, the publishers solicit letters from all among them who make the study of those objects a pleasure, or a profession.

Subscribers would confer a favor upon us by remitting *CHECKS or POST OFFICE MONEY ORDERS*, as we are frequent losers where money is enclosed in letters.

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☞ *All Collections for Advertisements, Subscriptions, etc., are made directly from this Office. We have Agents to solicit the same, but they are not authorized to Receipt for Money.*

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GENERAL EDITORIAL.

SUBWAYS FOR GAS AND WATER MAINS.

The inconvenience attending the repeated breaking up of streets for the purpose of introducing gas or water pipes into houses, has been long felt by the residents of this and other large cities. Where but one gas or water company exists the practice is bad enough, but where several mains are situated in one thoroughfare and it is necessary to make connections with either, the trouble and inconvenience arising from the disordered condition of the street is annoying in the extreme. Even when the work is done and the pavement replaced, the settling of the freshly filled earth causes depression in the streets which are dangerous to the wheels and axles of vehicles.

In London, where the evils attending the breaking up of the streets are more seriously felt than here, owing to the number of mains traversing single avenues, subways are built; and the favorable experience of the working of those now in use, has led to a decided partiality for them, and to a desire for more of similar construction. In some of the streets of that city, the gas and water mains lay side by side, almost in contact, and filling the entire street. Where so many opposition gas-light companies are carrying on a vigorous competiton, it is no unusual matter for consumers, from some fancied wrong to withdraw their patronage from one company and derive their supply from the mains of another. This leads to further alterations, and the consequence is, that trenches are being frequently dug, and the pavements of the streets left in the most unsightly and almost impassable condition. The evils arising from this state of affairs drew the attention of those having the highways in charge, and subways were resorted to as a relief.

In Paris, also, subways are provided for the gas and water mains, and in fact this system of laying mains, and of disposing of the annoyances above referred to, was first adopted and carried into practical effect by the ex-Emperor Napoleon.

The opinion of the officers of gas companies is almost unanimous in favor of subways. To say nothing of the diminution of labor in attaching service pipes to mains, other benefits would accrue to them. Their mains would not be embedded in an absorbant material like the clay underlying London, but would merely rest upon the floor of an underground apartment, where access might be had to them at any time, and such measures resorted to as necessary to stop the enormous leakage which now ensues. This leakage, which is estimated as high as 10 per cent. of the whole quantity of gas made, escapes principally through defective joints, and entering the earth is there absorbed, and partially deodorized, or its smell so masked by other effluvia as to render the detection of the particular spot where the leakage occurs extremely difficult, if not impossible. In a subway, on the contrary, the mains could be examined with the same precision as pipes and fittings in the houses of consumers, and thus the precise places where the loss occurs be observed. and the leak stopped.

The bursting of the Croton main has caused much trouble, and at times impeded the progress of pedestrians, owing to the street being upturned to discover the leak. Had a subway contained these mains, no bursting would occur, for it is brought about solely by the inequality of the trench in which they are laid, and the pressure of the superincumbent earth. But if the rupture occurs in a subway it can easily be got at, without the necessity of employing an army of laborers, and digging up whole squares at a time to find a break. The time may come when subways will be considered indispensable in all large cities. Meantime the experience of their use in London and Paris ought to be regarded with interest, and we hope to be able to lay before our readers any information in regard to them which may transpire.

THE GAS SUPPLY OF THE CITY OF LONDON.

We notice in the London *Artizan* of 1st instant, that Dr. Letheby, the chief gas examiner appointed by the Board of Trade, has recently presented to the Court of Common Council a report on the results of the daily testings of gas supplied to that city during the past quarter by the City of London, the Chartered, and the Great Central Companies. With respect to the illuminating power, he states that the common gas has ranged from an average of 16·93 standard sperm candles in the case of the Chartered Company at Gray's-in-road, to 18·34 in that of the Great Central Company at Friendly-place, Mile-end. The average proportions of illuminating power at the several testing places has been as follows:

City of London Company cannel gas 25·87 and common gas 17·37.

Chartered Company, at Leadenhall street, 17·64, and Gray's-in-lane, 16·93.

Great Central Company, 18·34.

The power has thus been at all times above the requirements of the Act of Parliament.

As regards impurity, sulphuretted hydrogen had not been present at any time in the gas of any of the companies during the quarter, and the amount of sulphur in any other form had ranged from an average of 13·28 grains per 100 cubic feet of the cannel gas of the City of London, to 27·87 grains in the common gas of the Chartered Company.

The maximum, minimum, and average amounts of sulphur were as follows:

City Company, cannel gas, 17·5, 9·6, and 13·28; common gas, 26·4, 15·0, and 21·84.

Chartered Company at Leadenhall street, 27·6, 15·3, and 22·97. Gray's-inn-lane, 34·5, 18·1, and 27·87.

Great Central Company, 31·7, 12·4, and 21·19.

The amount of ammonia had not exceeded the prescribed quantity of five grains per 100 cubic feet, excepting on twelve occasions, from the 12th to the 25th of July last, when the gas of the Chartered Company at Leadenhall street was overcharged with that impurity, but the excess arose from accidental circumstances, over which the company had no control.

TRADE-MARK—PATENTS.

The new Statute on Trade-marks, enacted July 8th, 1870, is well worthy the attention of all manufacturers. Letters patent for trade-marks are now issued for 30 years, and may be extended 30 years more, on expiration of the first term, at a small additional expense. This protects the party or firm against infringement in the use of the *name, vignette,* or *embem* used to distinguish their manufactures from those of others. We are prepared to give full information in writing, and copies of the law on trade-marks, and perform all the business necessary to secure said protection.

Next in importance to our business of securing patents for inventors in the United States, is that of our Foreign Patent Agency, and this branch of business is rapidly increasing. In many instances English and Continental patents rapidly inure to the great benefit of the patentees. One of our clients has just returned from England, where he

has realized $60,000 on his invention on which he had already realized $20,000 in this country. This too, was a patent which two other patent attorneys had successively failed to obtain, after nearly a year's effort.

The appended extract from the *Anglo-American Times*, is pertinent, and suggestive, and we therefore close with it:

"VALUE OF EUROPEAN PATENTS.—The American origin of an invention is now a recommendation in Europe, where many of these inventions are in successful operation, and large fortunes have been realized by their introduction. Improvements relating to some manufactures are of great value in this kingdom. Mr. Bessemer derives an annual income of about $2,000,000 from his British steel patents, and the patentee of a device for dressing millstones by a revolving diamond, has realized over $1,000,000 the first year of his patent. The use of a diamond for this purpose is an American invention, and the estimated value of the exclusive right in England, for ten years, is $5,000,000. British patents, as a rule, are the most valuable, but many inventions are equally profitable in other parts of Europe, and some are peculiarly adapted to Continental wants and customs."

SMEDBERG'S "SYNOPSIS OF BRITISH GAS-LIGHTING."

It is with a degree of pleasure that we clip the following item from the *Scientific Press* of San Francisco:

"A BOOK LONG NEEDED.—We have before us the 'Engineers' Index to the London Journal of Gas-Lighting,' compiled by Mr. James R. Smedberg, Consulting Engineer, San Francisco Gas Co. Full sets of this Journal are very rare and expensive, there being, we believe, but three in the whole country. Hence, the value of the Index, *as such*, is limited. But it serves the useful purpose of showing the scope of 'The Synopsis of British Gas-Lighting,' projected by Mr. Smedberg about two years ago, at the instance of the great gas companies, and now ready for the printer. This work will be a comdlete and compendious record of gas-making during twenty years, embracing 900 monographs on the various processes, and 1200 patents. It will be sold only by subscription, at $15 per copy. As a valuable contribntion to our technical literature, and an additional evidence of the varied industry of the Pacific Coast, we wish it every success."

Those who have not subscribed for this work, still have the opportunity to do so, by addressing Editors AMERICAN GAS-LIGHT JOURNAL, 42 Pine street, New York. Subscription payable when the work is ready to deliver.

ENGLISH ENAMELS.

The art of porcelainizing, or enameling, metallic and other utensils and objects, whether to prevent the corrosion by the action of air, water, and heat, or to form the beautiful glazed and vitrified surface as a finish, has become a branch of industry of great importance. In Europe this art has arrived at a high state of perfection, and in England especially, do we obtain the evidence that this work is uparalleled in the variety of its application—the variety and delicacy of colors, and the beauty of its finish and durability.

Messrs. J. H. Robinson & Co., 347 Grafton street, Liverpool, have taken the lead in this branch of industry, and through secrets in the process of their own, have succeeded in producing enamels of certain specialities, superior to anything in Europe or America. On this account their work is sought for and has a world-wide reputation. Their make of gas, water, and station meters, clock, time-piece, tell-tale, and log dials, lettered addresses, numbers, name plates, &c., are imperishable and unsurpassed. We beg to refer to their advertisement on page 153.

LYCEUM OF NATURAL HISTORY.—At a meeting of this society, held at 64 Madison Ave., on Monday evening, the 14th inst., the following papers were read: By Dr. Isidor Walz; "On the reduction o Sulphuric Acid"; also, "On a new Derivative of Chloral Hydrate." By Professor Henry Wurtz: "Lithology of the Palisade Range, with some remarks on Lithological Densimetry." In our next issue we will refer to them more fully.

GAS SCREENS.—The Duffee Gas Screen, manufactured by the American Gas Screen Company, Haverhill, Mass., is much liked by those who have tried them. We understand the company are having orders come in as fast as they can attend to them.

"THE CHEMICAL HISTORY OF A CANDLE."—Owing to a press of other matter on our columns, we were compelled to omit the continuation of the above entitled article for the two issues last past, but now resume the same in the prsent issue.

NEW BOOK, Etc.

Explosion of Steam Boilers; HOW THEY ARE CAUSED, AND HOW THEY MAY BE PREVENTED. By J. R. Johnson, Steam Engineer of Boston, Mass.

The author of this work has evidently given much attention to the subject of explosions of steam boilers and in this little book has given the results of his experiments and experiences. Several new facts regarding the cause of steam boilers are fully explained, which heretofore have puzzled the best engineers in the country. Knowing these facts it is plain that explosions can be prevented, and the great *Moloch* of sudden destruction may be thus disarmed, to the infinite benefit of the public, as well as private interests. The author of such a work is deserving of credit, as being not only a theoretical but a truly practical engineer, also a philanthropist in every sense of the word.

This valuable and timely work is published by Little, Brown & Co., 110 Washington street, Boston.

The People's Literary Companion, for November, comes to us as bright and as fresh looking as the green fields are after a rain. It is published by E. C. Allen & Co., Augusta, Maine. Terms, 75 cents per year. A fine steel engraving, entitled "From Shore to Shore," is presented to every new subscriber. It is really one of the most pleasing engravings ever before the public. The *Companion* is printed on fine, heavy paper; its columns are filled to the brim with good things by talented authors, and withal it is one of the largest and finest illustrated family papers published.

Answers to Correspondents.

F. A. H. of Pa.—A water which holds in solution only 5 or 6 grains of solid matter, may be considered very pure, unless the salts are in themselves particularly unwholesome. The Schuylkill river at Philadelphia, contains about the above quantity, and is considered a very pure stream.

E. B. K. of N. H.—The date of Murdoch's first practical application of coal gas for illuminating purposes was 1792. Six years later, in 1798, he illuminated the Soho works.

E. L. Y. of Ind.—The ammoniacal liquor is carefully economized in England, and used in the manufacture of various salts. It is a reproach to our character for enterprise that in this country it is mostly wasted.

E. J. of Wis.—Advertise your wants in the Journal, and you will receive replies, from which you can make your selection.

A. J. of Mass.—Cold carbonic oxide gas, when burned, gives a blue flame, but when previously heated, it burns with a yellowish red flame.

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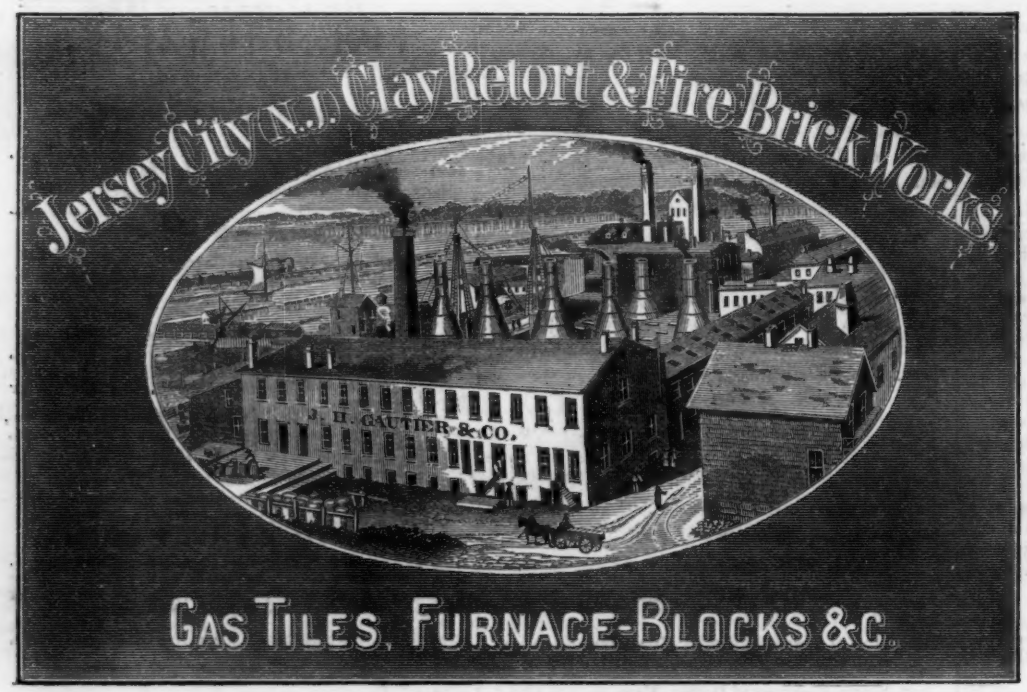

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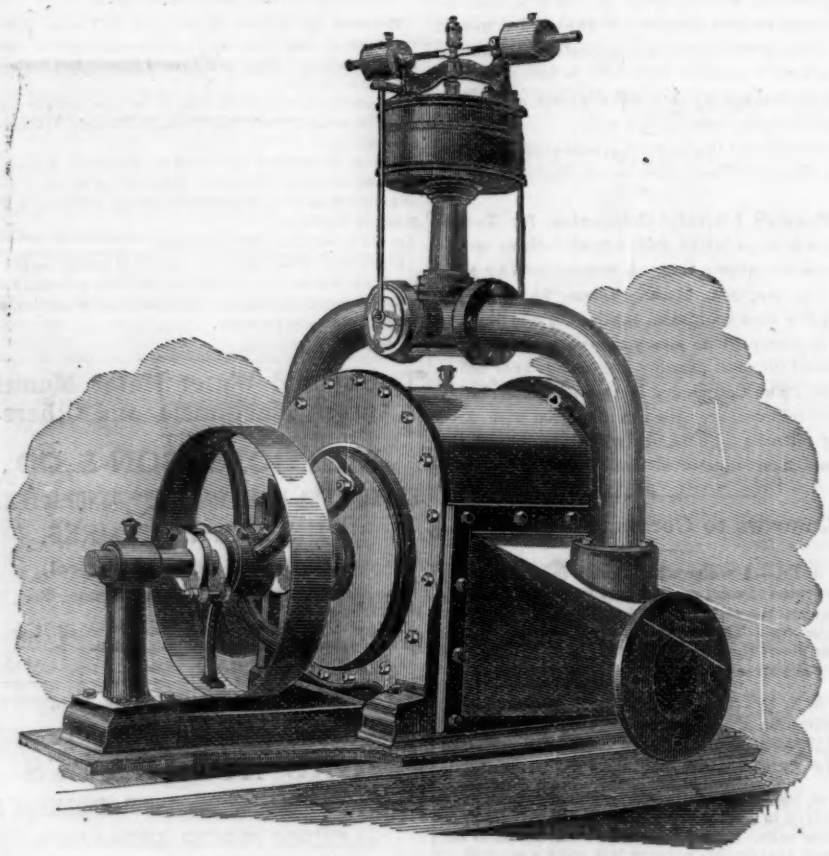

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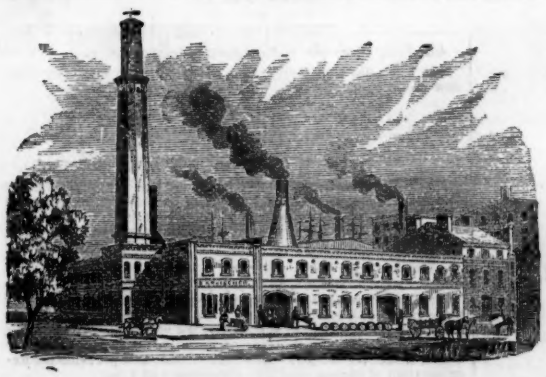

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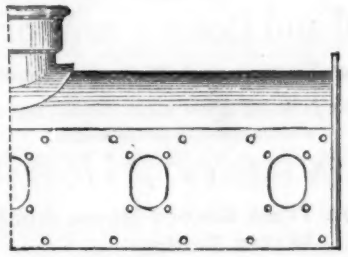

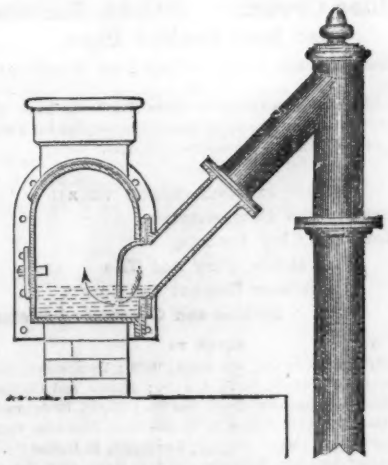

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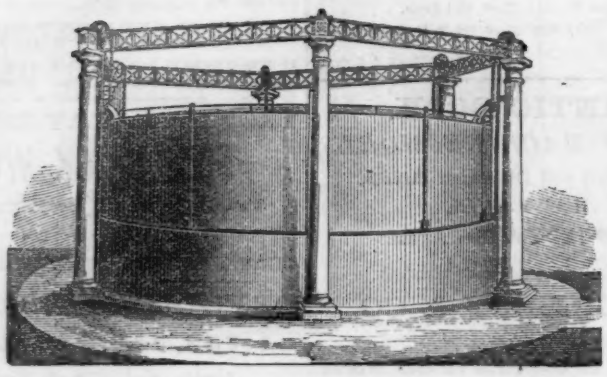

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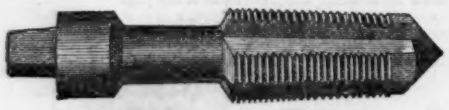

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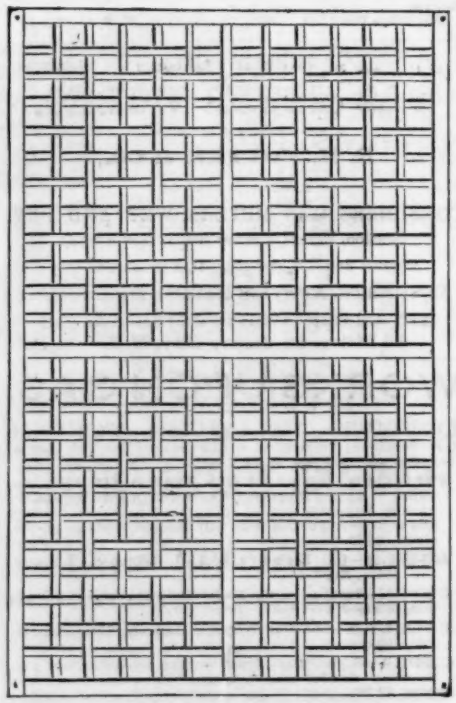

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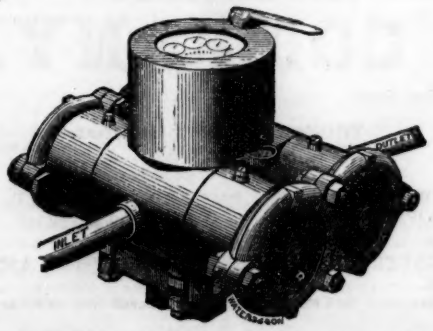

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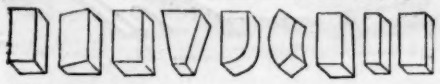

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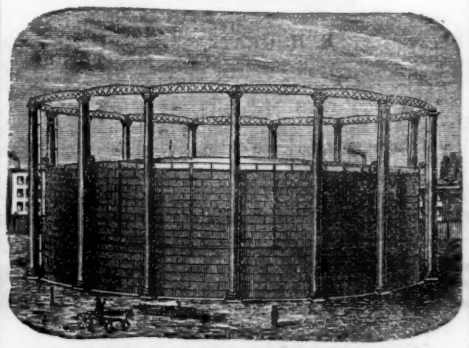

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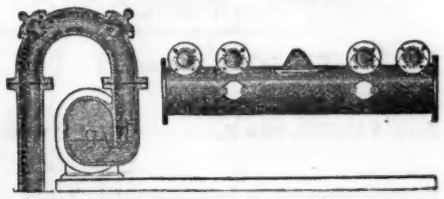

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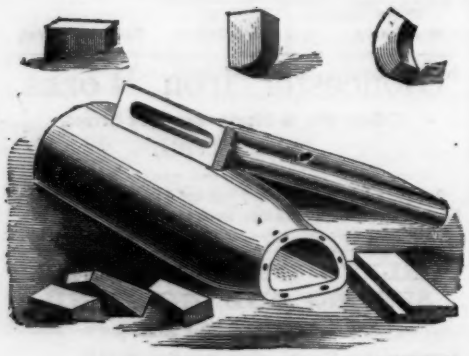

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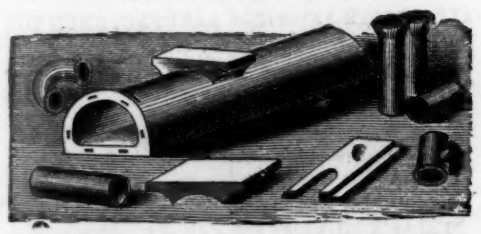

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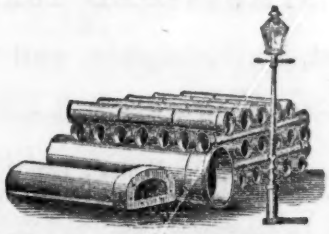

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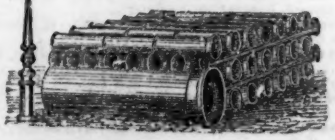

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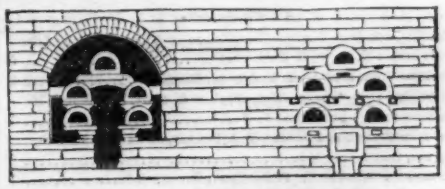

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